CALIBRATION OF A DEEP-SOUNDING RADIOMETER FOR A JUPITER FLYBY

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A microwave deep atmosphere sounding experiment for Jupiter has been proposed as a NASA Discovery Mission. Named "JASSI" for Jupiter Atmospheric Sounding and Sensing of the Interior, this mission would send a spacecraft with a microwave sounder and other instrumentation on a close flyby of Jupiter. The sounder instrument includes multiple continuum radiometric channels to probe the atmosphere from the visible cloud tops to depths well below the putative water clouds. If sufficiently well calibrated, the data will enable the determination of the oxygen and nitrogen content of Jupiter to accuracy sufficient to create a breakthrough in our understanding of how major planets like Jupiter form out of a protoplanetary nebula.

Our study shows that 2% radiometric accuracy is required at all frequencies. Such accuracy is impossible from the Earth because powerful synchrotron emission from Jupiter's radiation belts overwhelms the atmospheric thermal emission at the deep-sounding frequencies. The JASSI spacecraft will pass inside the radiation belts so that for most of the trajectory the synchrotron emission will appear only in the back hemisphere of the antenna patterns. Because the spacecraft passes close to Jupiter, the sounding can be achieved with a broad beam antenna having sufficiently low sidelobe and backlobe responses. At the lowest frequencies (≤ 2 GHz) we plan to use a patch array antenna design based on a 61-element antenna built by Loral Space Systems that was flown on their Globalstar satellite. Horn antennas will be used at higher frequencies.

Radiometric calibration will be achieved through the use of noise sources and frequent comparisons with internal thermal calibration loads in flight. We anticipate challenges in the area of end-to-end thermal vacuum calibration of the radiometers on the ground, especially at the lowest frequencies where we must account fully for the properties of the array antennas.